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Arjuna Flenner* (arjuna.flenner@navy.mil). *Exploitation of Graphical Models to Guide Deep Representations*. Preliminary report.

Recently, the graph theory, PDE, and optimization communities have generated algorithms to analyze pairwise relationships between high dimensional data samples using graph segmentation and clustering algorithms. Concurrently, the machine learning community has developed a representation learning strategy, deep learning, that obtains human levels of performance for many image and voice classification data sets. These deep architectures learn a multi-layer collection of representations where a representation at a higher layer is related to the lower layer through a nonlinear pooling operator, which results in down-sampling and dimensionality reduction. The pooling strategy is chosen to create a final representation that is robust to deformations along a pre-specified group operation, such as the translation group, and much of the success of the deep architectures is attributed to this pooling step. This work devises a framework that incorporates the pairwise relationships of graphical data, which may be difficult to describe using a distance or metric, into the deep learning architecture that is consistent with the pooling structure. We demonstrate this framework in three tasks: database organization, regression, and classification. (Received September 21, 2015)